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MILITARY GEOLOGY

Chapter 2. HISTORY OF THE DEVELOPMENT OF MILITARY GEOLOGY

Geology in Military Science up to World War I

As early as 1868, the British Maj-Gen John Fortlock, who was at the same time a general and a geologist, said in his article, "A Rudimentary Treatise on Geology":

"At the present time geology is a genuine science, based on facts and exact laws, according to which it constitutes a true guide for practical action. The military man thus finds in geology valuable instruction in planning either offensive or defensive operations."

The application of geology to military problems was given the most consideration by French geographers, since France and the other countries at that time in military topographical research. In France, especially in the northern and eastern parts, the relationship of the river systems and the various relief features to the geological structure of the locality and its history is so clearly expressed that it is not astonishing that the French, perceiving this relationship, were the first to recognize the utility of geology for military topography.

In the interests of their country's defense, French commanders had for a long time been obliged to make a systematic and detailed study of the natural conditions of their country, which has been the battlefield of many European wars.

Geology was studied from the military point of view for the first time and most thoroughly by Perandiere in his work which appeared in Paris in 1882 under the title of Topographie strategique et prodrome de geologie militaire (Strategical Topography and Introduction to Military Geology).

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Later, in the 1890's, a course of lectures was offered on this subject by Captain Vallot at the La Fere infantry school. The question of the influence of physiogeographical conditions upon the conduct of military operations was clearly presented in the work of A. Marga, which emphasized the influence of soil and geological conditions upon the solution of problems concerning the swift transfer of troops, the location of lines of defence, etc.

The most consistently maintained physiogeographical trend is found in Barre's published lectures at the artillery and engineering school at Fontainebleau. Barre was both a good engineer and a prominent geologist. In his works, he illustrates with numerous examples the great importance of tectonics and geology to military operations. As Brooks points out, Barre foresaw, with astonishing accuracy two decades beforehand, the influence which afterwards was to be made manifest by the physiogeographical conditions of the Western European theater in the course of operations from 1914 - 1918.

In other countries, military geology was not studied systematically before World War I. It may be noted, however, that in the 1880's and 1890's of the last century, British officers who received instruction in Camberley War College had a rather good preparation in geology. The course of lectures on military geology at that school was given by the widely-informed and prominent geologist, Lt Col Ch. Cooper-King, RA. King was evidently the first British professional military man who recognized the necessity of wide application of geology in military science. His lectures analyzed in sufficient detail and with illustrative examples the influence of geology and its significance in military operations.

The conception of military geology evidenced during World War I was unknown until then. The first military-geological program was formulated in 1913 by the German geologist, Kranz, who, beginning in 1908, participated in the construction of a number of fortresses as an officer of the engineers. In his study, "Military Geology" published in the magazine, Kriegstechnische Zeitschrift, (Military Technical Magazine), he sets forth the results of his geological observations during the building of the fortresses. He analyzed in detail the role of subsoil waters in the water supply of military objectives and also the importance of mineral construction materials in military-engineering work.

Military Geology in World War I

In World War I the application of geology and the use of military and civilian geologist in immediate connection with the armies of the belligerent powers was found to be in direct relation to the nature of the organization of military-geological services. Since each country's militarists understood the geologist's war role differently, the use of geology as an auxiliary military implement and the organization of military-geological services in the various armies differed. In certain armies a special, military-geological service was organized; in others there was none, and in working out military-geological objectives, geological institutes, and individual civilian geologists were called upon. That was the case in the Russian and French Armies. In the British, American, German and Austrian Armies a special military-geological service was organized. The basic objectives which then confronted the various geologists derived from the predominantly positional character of the past war and consisted mainly in finding a basis for the troops' water-supply, in fortification works, particularly in underground mine work, in the search for construction materials, and in various types of specialized geological works.

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The Russian Army was already resorting to the aid of geologists in the Russian-Japanese War, 1904-1905. The geologists, called into the army without having specialized preparation for the work, could not render effective service, in spite of the fact that such service was badly needed in the construction of fortresses. Such unsuccessful experience, however, did not draw the attention of the high command of the Tsarist army to any great degree. Consequently, the Russian Army began World War I as unprepared in military-geology as the armies of the other countries.

There was no specialized military-geological service, but the need for geological aid became apparent from the very beginning of hostilities in eastern Prussia and Galicia. In view of this, several civilian organizations came to the aid of the front, particularly the Department of Land Improvement of the Ministry of Agriculture, which had already drawn up in 1914 a special hydrotechnical organization for the needs of the active army. That organization stayed deep in the rear, and its work was limited to technical consultations and insignificant measures for the improvement of water-supply and sanitary-technical arrangements for hospitals, staging areas, etc.

Not until it was transferred to Warsaw did the nature of this organization's activity change somewhat, although its main role consisted, as before, of works connected with the improvement of water-supply and sanitary-technical measures. In addition, works of a different nature began to be realized: draining of trenches and land, improvement of roads in swamps, flooding and making swamps of certain areas and many other types of work on the Novogeorgiev and Ivangorod fortresses. At that time, geologists were drawing conclusions only on the basis of existing literature and archival data without any hydrogeological field explorations whatever, for there was no time for them under conditions of warfare or maneuver. Later, four administrations of military-geological works were formed to serve the northwestern, western, southwestern, and Caucasian fronts. The administrations were subordinate to the officers in charge of front-line engineering services.

Among the tasks of the hydrogeological section of each administration were included the following:

1. Distribution, to engineer-hydrotechnicians, of information concerning the geological structure of the section within whose limits the administration's works were carried on.
2. Formulation of conclusions on hydrogeological conditions of flooding, swamping, and drainage works, by region.
3. Execution of field hydrogeological investigations in the various sections.
4. Formulation of conclusions on the accuracy of projects from the hydrogeological standpoint and estimates on the construction of tubular wells.
5. Hydrogeological observation during the process of drilling.
6. Formulation of conclusions, in case of difficulties arising during the drilling process, caused by the peculiarities of the hydrological conditions of the locality.
7. Formulation of collated tables for each shaft drilled.
8. Scientific laboratory processing of drilling data, drilling notes, daily records, cross sections.

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9. Collection of existing data on the geology and hydrogeology of the site of operations.

10. Registration of all previously drilled and equipped shafts in the region of the hydrogeological administration's works.

The geologists were obliged to devote a great deal of attention to the assembly and systematization of material on previously drilled shafts, since available data was limited and there was not sufficient time to solve a great many practical problems.

Towards the end of the war, a technical department, attached to the construction-technical unit of the western front (Russia's western front), was organized. The department consulted with the geologists, A. G. Sergeyev and G. A. Kharchukhnikov. On the initiative of K. I. Volichko, Chief Engineer of the Southwestern Front, geologists were assigned to search for construction materials (especially raw materials for the preparation of cement) and were called upon for consultations on blasting works and for the search for fuel, of which there was a shortage.

On the initiative of the Chief Engineer of the Eighth Army (in Romania), consultant geologists were called upon for road work and for prospecting for various field minerals (for example, salt, dyestuff) and for consultations on work for establishing positions, mine galleries, etc.

Another organization which left more or less noticeable traces of its activity in the field of geological service to the Russian Army was the Raw Materials Commission attached to the chemical department of the Military-technical Service of the combined scientific and technical organizations. The Raw Materials Commission was organized at the end of 1945 at the instigation of V. I. Vernadskiy and A. E. Perezman.

Among the duties of the commission were the following: (1) systematic accounting of stores of mineral raw materials and their consumption by the various organizations; (2) consultations upon the exploitation and use of mineral raw materials for defense needs; (3) issuing of reference maps of construction materials and field minerals in the front-line areas.

Many works connected with the geological servicing of the front during World War I were likewise carried on by the former Geological Commission of the Department of Mines. Under the guidance of the geologists, M. M. Prigorovskiy and N. F. Pogrebov, the commission organized the distribution of necessary and urgent information in answer to the inquiries of the various organizations serving the current needs of the active army and the economy of the country.

The Geological Commission rendered technical aid to the surveying party of the Military-Industrial Committee in its search for beds of mineral fuel on the Caucasian Front (D. V. Nalivkin, A. A. Stoyanov, B. F. Meffert, et al.).

Similarly, no military-geological service was organized in the French Army, and all its needs were served by civilian organizations. Only towards the end of the war did officers of the engineers of the French Army begin to function in their capacity as geologists. (They were attached to the command staff, to the armies, and to the water-supply service.)

As the war on the Western Front was waged mainly on French territory, the majority of officers of the French Army, having a fairly sound preparation in geology, knew very well that the geological service was less important for them than for the expeditionary forces of her allies and for Germany. The Germans showed how dearly they paid for their lack of knowledge of the geological literature of the neighboring countries, particularly France and Belgium,

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on whose territory they were obliged to wage war. Many French engineers, who worked on the water-supply services in the army also know geology very well and could, themselves, make geological investigations. According to Brooks, it was very often possible during the war to observe French engineers using geological maps in the location of shelters.

Thus, although the French had organized no geological service, the good geological training of the officers permitted the army to exploit skillfully and opportunely the geological peculiarities of one area and another. In various cases, the French Army made use of advisory civilian geologists. Franz points out that in August 1917, from Fosse's position on the French front, German troops several times observed a civilian who went into shell holes and knocked on rocks with a hammer. They called him the mountain spirit of Bouaumont. He was proven later by the interrogation of prisoners and the testimony of spies, he was a military geologist in civilian clothes.

Throughout the whole course of the war, the French Army made wide use of existing and newly compiled maps, sections, and specialized, geological literature. All this material was supplied by civilian institutions. Especially noteworthy is the fact that the French were the first in the past war to pay great attention to the compilation of special maps which characterized the influence of soil conditions on terrain traversability. In the summer of 1918, in the Geographic Institute, where a number of outstanding geologists worked, the composition of "tank maps" was begun. With the aid of geologists, the Institute undertook a description of the physiogeographical peculiarities of the combat theater and a resume of Germany's mineral resources and mining industries.

Information is very meager concerning the Belgian Army. From a private letter of the geologist, Ren'o [Fignend ?], to Brooks, it is known that the former chief of the military-engineering units of the Belgian Army, General Graindel, who was secretary of the Belgian-Geological Society for a long time before the war, made full use of his good geological information on the combat theater.

The British Army was the first to feel the drawbacks of not having information on the geological conditions of an area in which it had to wage war. In the very beginning of 1915, the commanding staff ordered several geology specialists from London, including Captain King. The latter was attached as a geologist to the Chief of the Engineering Corps of the British Expeditionary Army and was immediately assigned chief of the water-supply service. His basic duty was to clarify all questions connected with the evaluation of the water resources of the various areas. He was also charged with working out a system of preserving the surface waters in flat Flanders, an undertaking which had very great practical significance for the British Army both in offensive and defensive operations.

In a year's time the British Army initiated the use of geology in underground-mine warfare and organized an administration which was in control of work connected with the establishment of positions and the conduct of mine warfare. Colonel David, professor at Sydney University, was at first named as consultant geologist for these matters and was attached to the Engineering Corps, but afterwards he was named inspector of a tunnel company, attached to the General Staff, and chief of that specialized administration. From time to time other geologists and mining engineers from among the officers of the tunnel company, who knew the geology of the Western Front intimately, were assigned to this administration. They carried on military-geological investigations and compiled geological maps of theaters of impending combat. Moreover, from the very beginning of 1916, officers were assigned to each army for prospecting work, the results of which were systematically reported to

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GHQ. In the British Army in Palestine there apparently was an independent geological service, whose chief geologist was R. V. Brook (TR: Bibliography lists A. Brooke only).

The administration of the water-supply service, apart from its current field investigations and direct management of work on water-point installations, compiled water-supply maps, predominantly on the scale of 1:100,000. They contained a quantitative evaluation of the productivity of water points and of water resources (in L/sek) [liters per second ?].

According to the testimony of many authoritative representatives of the British Army Command, the work of geologists secured the success of very many engineering projects and military operations, particularly in the matter of organizing military water supply, the conduct of underground-mine warfare, and the search for mineral construction materials.

The American Expeditionary Forces had a special geological section attached to the chief engineer's staff. The chief geologist of this section headed the technical management of all army geological works, including hydro-geological investigation, which was carried out by a special water-supply section. In 1918, geologists were appointed on the basis of one for every corps. They were members of the chief engineer's staff and were in charge of all problems of geological prospecting, rendering practical aid to the water-supply service.

The American geologists applied geology in diverse ways in various types of fortification construction (terrain fortification, construction of shelters) and in the organization of water supply and the installation of water points.

In the solution of many practical tasks, wide use was made of geologists who had specially compiled maps and reports, and who had made personal observations. At the beginning of the war, the Americans very often used French or Belgian geological maps. Later, however, when more detailed geological investigations were carried out, they began to compile special engineering-geological maps. Maps of this type were compiled for all fronts on the scale of 1:50,000 and were constructed on the principle of demarcation of the strata of different lithological composition. Their importance in the construction of fortifications was pointed out in the description of the lithological differences of the strata in the legend.

In contrast to the maps of other armies, in American engineering maps, as a rule, important territory occupied by the enemy was clearly described. The American geologists compiled reports concerning the significance of geology for fortification construction and underground mine laying, concerning conditions of river crossings, of the possible resources of surface waters, etc. The American geologists put an especially great amount of work into the compilation of accounts and specialized maps of water resources for areas occupied by the enemy.

In the rear, American geologists were called upon to work on the search for strategic raw materials and the study of the enemy's mineral resources, both of which were important for military strategy.

The selection of important enemy industrial points for aerial and artillery bombardment, and the furnishing of practical directions upon the most valuable and important objectives must be noted among the operational-tactical tasks which involved the participation of American geologists.

In the National Academy of Sciences in America, the National Research Council, composed of a whole series of sections and groups, was formed as an

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aid to the military-geological section. Among the tasks of the geological and geographical section was that of improving its own position from the point of view of geologists' and geographers' experience and information in working out all basic military problems. A great deal of attention was paid to the geological preparation of officers.

In the German Army in the beginning of World War I, the command underestimated the role of geology, and military-geological services were lacking.

However, the German Army began to avail itself of the services of geology in various sections, beginning in the winter of 1914-1915. It is known that in that period military-geological work connected with water supply, drainage, and the appraisal of geological conditions of fortification construction was carried on in the northwest front in the area of operations of the Fourth Army, and also in the Strasbourg fortified area. Geologists and hydrotechnicians also conducted special detail work in the installation and reconditioning of wells. Later, in the expansion of the status of the geological section attached to the Construction Administration, geologists undertook a systematic military-geological mapping of the Vosges Mountains. Among their military-geological works was the study of the subsoil and surface waters of the Bois de Breton region in the Moselle River basin, carried out by the pioneer geologists Philipp and Herbert [Philipp and Herbert?]. These investigations rendered great aid to the army of this sector of the front. Army headquarters recognized such investigations as extremely necessary, and toward the end of 1915 the group of geologists was expanded to 40 men. They performed the military-geological studies of water supply and drainage, searched for and extracted stone construction materials, studied the structural properties of the strata, and compiled readily legible geological maps. Almost at the same time, in 1915, at the instigation of geologists, the Special Geological Bureau was founded at the University of Lille and a library and laboratory for the study of the geology of Belgium was established in Brussels (Geologist, A. Leylo). This aid which the various German armies received from geologists at the beginning of the war, largely on the private initiative of the geologists, played its part, and the command began to recognize the significance and role of the geology of a terrain in its military undertakings. By the middle of 1915, the German Army Command indicated the necessity of making geologists available for servicing army needs.

Military geology found official recognition in the German Army only in 1917, when the Military-Geological Service was organized and attached to the Military-Topographical Section of the General Staff. Corresponding to the structure of the military-topographical service, military geologists were formed into groups or sections which serviced the army and operated with the various units on the tasks assigned by the section's commander. In all, there were 28 sections. Apart from these organizations which carried out field work, there were also military-geological organizations in the rear and staging areas, the so-called geological information sections. One of these was in Lille, another in Brussels and a third in Metz. These sections did not carry on field operations and were staffed by geologists who knew geological literature and archival material very well. The work of these sections was to assemble and systematize material, collate descriptions and maps necessary for the work of the field geologists, and to execute, in part, the laboratory processing of materials received from the front-line field sections.

Both field and rear geological sections or groups maintained close liaison with the Central Military Geological Institute, founded in Berlin in 1916. The Institute had at its disposal the archives, the library, and all the equipment of the Prussian Geological Institute. The receipt of materials was very difficult since the borders were closed. Therefore, the Institute had about 100 of its workers in foreign countries, both belligerent and neutral. Throughout the war the Institute sent to the front up to 6,000 maps of

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different types and much equipment of various kinds. All the work of the field and army /sic/ geologists was sent in to the Institute where it was systematized and generalized. The principal function of the Institute was to draw conclusions intended for staffs and military units.

The Institute also compiled, and distributed to troop units, existing information and directive brochures, which were most often called "handbooks." Institute specialists also participated in preparing precepts and regulations. Naturally, a great part of those conclusions were not printed. Much of such material was lost without leaving a trace at the time of retreat. There are indications from the Czech geologist, Hlavka, to the effect that a great amount of such work was handed over to the French and the Belgians in time of peace. There is no accurate information on the number of geologists who worked in the German Army. It is only known that at the end of the war up to 260 men were working in the various sections of military geology, the majority of whom were in military service.

In the Austro-Hungarian Army, the services of geologists were utilized occasionally but never systematically from 1915 on.

Military-geological groups, analogous to the German groups, formulated conclusions, which were here called reports, and drew up military-geological maps of various kinds (water supply, fortification construction, etc.). The geologist, Hlavka, briefly describes in his work, Geologie v rakonsko-ukarske armade (Geology in the Austro-Hungarian Army), the specialized, geological maps of the Topographical Division in Trieste, with which he was acquainted.

Outstanding among the Czechs who worked in the field of military geology were the geologists, Dances, who did research on the Balkan caverns, Abtalon, Gartner, and Jares.

Characteristically, the Austro-Hungarian Army, long before the organization of the military-geological service, was obliged to create a special unit for mountain work, detachments of so-called "Alpine Reviewers," composed of mountain climbers who were charged with the study of mountain warfare conditions. In the Balkans, the Austrians, making use of the Budapest and Hungarian Academies of Science, organized several expeditions, mainly for the purpose of making geological maps and doing research in the newly occupied territories. A geological map of the northern part of Albania was composed under the direction of the geologist, Kerner.

Geologists also worked in the Japanese, Italian, Turkish and Bulgarian Armies; however, the character and organization of their work is not known.

The Swiss Army in 1914 had, in the hygienic section attached to its staff, engineer officers and military geologists, who worked on water-supply problems.

Military Geology in World War II

With the termination of World War I, the direct use of geology for military needs was sharply cut down in most countries. However, the experience of World War I was not forgotten, and after the war the processing of accumulated material began in all countries, with the result that a vast literature on military geology was amassed.

In the USSR a great deal of attention was devoted to the question of the use of geology in military science, as is testified by the bulk of material on military geology published in periodical literature. Shortly thereafter, the manuals of Andreyev and Benadictov on military geology appeared,

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as well as translations of the books of the American geologist, Brooks, and the English geologist, King, in which the question of the use of geology in World War I is thoroughly elucidated. Although collated works dealing with the work of Russian geologists at the fronts were never published, their basic findings were taken into consideration in planning the defensive measures of our country.

In other countries at that time, a great deal of material was published clarifying in its various phases the application of geology to military science. But the most extensive work, Material on the Geological Description of the Theaters of the 1914-1918 War (Materiali po geologicheskomy opisaniiyu teatrov voyay 1914-1918) (in 13 issues) edited by Vil'ner (TN: transliteration of the Russian), treats in the main a range of purely geological questions without studying them from the military point of view.

Beginning in 1930, in all countries, but especially in Germany, military-geological literature took on an agitational character. Stress was laid on the question of the necessity in peacetime of proper training in military-geological servicing of armies for time of war. A great deal of attention was paid to the military-geological training of officers. Large-scale studies of possible theaters of combat were intensively carried out. Various types of military-geological maps, sections, reference charts, sketches and descriptions were prepared in advance. Similarly, methods were perfected in compiling military-geological documentation in accordance with the changing character of warfare and the growing importance of such arms as aviation and tanks. Geologists were widely attracted to the various types of military engineering fortification, military-hydrotechnical work, etc., and to the study of the resources in strategic, mineral raw materials of one's own country and the evaluation in this respect of the potentialities of other countries.

Geologists were frequently consulted during the entire preparatory fortification of state frontiers, both in France, where the Maginot line was being erected, and in Germany with the setting up of the Siegfried Line, the Eastern Wall and other large-scale fortified regions.

In the Abyssinian campaign, the Italian Army made wide use of geological and hydrogeological data in the search for sources of water supply and for construction materials for laying out military roads.

During its occupation of the Western European countries, the German Fascist Army used specialized geological maps, which were in the possession of the unit and general staffs.

It is known that geological data was taken into account by the Japanese occupation forces in China.

No small part was played by Soviet military geologists in strengthening the defenses of the USSR. Even in time of peace, Soviet geologists carried out great preparatory works of all types of military-geological services for the army.

During the years of the Stalin Five-Year Plans, great investigating and prospecting expeditions were carried out in the study of the subsoil depths and the geological features of our country. The materials gathered during these investigations are in a large measure studied for the general conclusions to be drawn from them, and they are used successfully for the various military needs both in the rear and at the front.

During the Finnish campaign, Soviet geologists rendered great aid to the field forces of the Red Army, fulfilling in very limited periods of time many complicated geological missions.

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Our forces made wide use of terrain-traversability maps and other specialized military maps compiled by geologists. The aid of geologists who knew the natural conditions of the combat theater facilitated the solution of many problems connected with the water supply of the troops, field-fortification construction, the construction and exploitation of air fields, etc.

From the very beginning of World War II, a great body of geology specialists was drawn to serve the immediate needs of the front. They very successfully aided the Red Army in the fight with the German invaders both in the organization of defense and in offensive operations.

The enormous extent of the zone of combat, which had extremely varied natural conditions, the mobile character of the war, the highly mechanized character of the army, the increased importance of tanks and motorized units and aviation, the complicated defensive works, all these together greatly emphasized the part played by military geology in World War II.

The swift tempo of the concentration and transfer of large numbers of troops and quantities of mechanized equipment alone demanded, first of all, the aid of geologists in the timely organization of the supply of good water for the troops. The unselfish work of Soviet geologists and hydrogeologists, often directly on the foremost lines of the front, successfully secured water for the troops, thus cooperating in the execution of military operations.

Owing to the very active aid of Soviet geologists and hydrogeologists in a great number of large inhabited places, duplicate water-supply systems were successfully created beforehand (artesian wells, shafts, etc.) and the undesirable consequences which occurred in other countries were avoided.

Soviet geologists also rendered very great aid in fortification construction of all types in the field and in the rear (in technical organization of the ground, in the construction and improvement of roads, airfields, etc.).

The services of the geologists who worked at the front in World War II were great, but no less great are the prospects of their participation, after the end of the war, in the task of technically equipping the frontiers and the territory of the USSR.

Bibliography

1. Benediktov, B., Voyennaya Geologia. Uchebnik dlya voyennykh shkol (Military Geology. Handbook for Military Schools), 1930
2. Brooks, A. and King, V., Primenenie geologii na voyne (Application of Geology to War) (TN: translation from English) ONTI (United Scientific-Technical Publishers), Leningrad, 1934
3. Bykover, N. A., Geology and War, Priroda, No 5-6, 1942
4. Markov, K. K., Military Geography, Izvestiya Vsesoyuznogo geograficheskogo obshchestva, No 1, 1943
5. Myrator, M. V., Problems of Military Geology, Problemy Sovetskoy geologii, No 3, 1933
6. Obrushev, V. A., Primenenie geologii v voyennom dele. Polevaya geologiya, (Use of Geology in Military Science. Field Geology), Vol II, 1934
7. Fersman, A. K., Geologia i vojna (Geology and War), Akademia Nauk, SSSR, 1943

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